

CLAIMS

1. Blind or partially blind process to determine characteristics space-time parameters of a propagation channel in a system comprising at least one reception sensor receiving a signal $y(t)$, characterized in that it comprises at least one step in which the specular type structure of the channel is used and a step for the joint determination of parameters such as antenna vectors (\mathbf{a}) and/or time vectors (τ) starting from second order statistics of the received signals.

2. Process according to claim 1, characterized in that it comprises a step in which the received signal is oversampled.

3. Process according to claim 1, characterized in that it comprises a step in which the signals are received on at least two sensors and a step in which the received signal is oversampled.

4. Process according to any one of claims 2 and 3, characterized in that the sampling period corresponds to T/p where T is the symbol period.

5. Process according to any one of claims 1 to 4, characterized in that it comprises at least the following steps:

- choose the length of the global propagation channel $\hat{L} \geq L_g + \Delta\tau_{\max}$ and the value of the number of observations $K \geq \hat{L}$ where $\Delta\tau_{\max}$ is the largest possible value of the relative delay between two paths
- determine the $Q_L(\hat{R})$ matrix of the sub-space criterion,
- estimate the number of paths \hat{d} ,

- estimate delays

$$\hat{\tau} = \arg \min_{\tau} J_{\hat{L}, \hat{d}}(\tau)$$

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$$J_{\hat{L}, \hat{d}}(\tau) = \frac{\lambda_{\min}(G_{\hat{L}, \hat{d}}(\tau)^H Q_{\hat{L}}(\hat{R}) G_{\hat{L}, \hat{d}}(\tau))}{\lambda_{\min}(G_{\hat{L}, \hat{d}}(\tau)^H G_{\hat{L}, \hat{d}}(\tau))}$$

- estimate the value of the antenna vector by

$$\hat{a} = \text{vp}_{\min}(G_{\hat{L}, \hat{d}}(\tau)^H Q_{\hat{L}}(\hat{R}) G_{\hat{L}, \hat{d}}(\hat{\tau}))$$

- form the estimate of the pulse response: $\hat{h} = G_{\hat{L}, \hat{d}}(\hat{\tau}) \hat{a}$

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6. Process according to one of claims 1 to 4, characterized in that it comprises at least the following steps:

- Estimate \hat{L}_g the length of the transmission filter and choose $\hat{L} \geq \hat{L}_g + \Delta \tau_{\max}$ and $K \geq \hat{L}$.

- 15 • Apply the sub-space method described in item 2 of the a priori process:

- Estimate the covariance matrix \hat{R} .
- Calculate the projection matrix onto noise space $\hat{\Pi}_{\hat{L}}$ using the eigenvectors associated with the $p(K+1) - (K + \hat{L} + 1)$ null eigenvalues of the matrix \hat{R} .
- 20 – Form the matrix $Q_{\hat{L}}(\hat{R}) = D_{\hat{L}}(\hat{\Pi}_{\hat{L}}) D_{\hat{L}}(\hat{\Pi}_{\hat{L}})^H$
- Obtain the \tilde{h} eigenvector associated with the smallest eigenvalue of the matrix $Q_{\hat{L}}(\hat{R})$ and form $\hat{h}_{\frac{T}{P}}(z)$

- Form the new parametric criterion:

- Choose the value of the channel length $R \geq \hat{L}_{\frac{T}{P}} = p(\hat{L} + 1) - 1$

And form the matrix $\tau_R (\hat{h}_{\frac{T}{p}}^T)$

- Calculate the matrix $\hat{\Omega}_{\hat{L}_{\frac{T}{p}}}$ containing the eigenvectors

associated with the $q(R + 1) - (R + \hat{L}_{\frac{T}{p}} + 1)$ smallest eigenvalues of τ_R

- 5 – Form the matrix $D_{\hat{L}_{\frac{T}{p}}}(\hat{\Omega}_{\hat{L}_{\frac{T}{p}}})$

- Estimate the number of paths \hat{d} ,
- Determine a minimum value of the transmission filter band: B,
- Choose $\tilde{v}(t)$, a continuous filter with a limited band B. Form the filter

10 $v(t)$,

$$\begin{cases} v(t) = \tilde{v}(t) & 0 \leq t \leq Lv \leq \hat{L}g \\ v(t) = 0 & \text{elsewhere} \end{cases}$$

- Estimate the delays

$$\hat{\tau} = \arg \min_{\tau} I_{\hat{L}, \hat{d}}(\tau)$$

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where

$$I_{\hat{L}, \hat{d}}(\tau) = \frac{\lambda_{\min}(V_{\hat{L}, \hat{d}}(\tau)^H D_{\hat{L}_{\frac{T}{p}}}(\hat{\Omega}_{\hat{L}_{\frac{T}{p}}}) D_{\hat{L}_{\frac{T}{p}}}(\hat{\Omega}_{\hat{L}_{\frac{T}{p}}})^H V_{\hat{L}, \hat{d}}(\tau))}{\lambda_{\min}(V_{\hat{L}, \hat{d}}(\tau)^H V_{\hat{L}, \hat{d}}(\tau))}$$

- 20 • Estimate antenna vectors:

$$\hat{\mathbf{a}} = v P_{\min}(V_{\hat{L}, \hat{d}}(\hat{\tau})^H D_{\hat{L}_{\frac{T}{p}}}(\hat{\Omega}_{\hat{L}_{\frac{T}{p}}}) D_{\hat{L}_{\frac{T}{p}}}(\hat{\Omega}_{\hat{L}_{\frac{T}{p}}})^H V_{\hat{L}, \hat{d}}(\hat{\tau}))$$

7. Application of the process according to any one of claims 1 to 6 to monitor the spectrum of a propagation channel for positioning purposes from one or several HF stations.

- 5 8. Application of the process according to any one of claims 1 to 6, for the standard communication links for equalization or positioning or spatial filtering.